CLAIMS

1. A nanogap array method for trapping, detecting, and identifying a substance, the method comprising the steps of providing a cantilever array including cantilevers each having a probe; providing a substrate below the cantilever array, the substrate having modified surfaces arranged so as to correspond to the probe of each cantilever; and trapping, detecting, and identifying at least one unknown substance in nanometer-sized gaps defined between the modified surfaces of the substrate and tips of the probes of the cantilevers.

2. The nanogap array method for trapping, detecting, and identifying a substance according to Claim 1, wherein the length of the gaps between the modified surfaces of the substrate and the tips of the probes of the cantilevers is known.

3. The nanogap array method for trapping, detecting, and identifying a substance according to Claim 2, wherein the length of the gaps is uniformly defined.

4. The nanogap array method for trapping, detecting, and identifying a substance according to Claim 2, wherein the gaps have a gradient in length.

5. The nanogap array method for trapping, detecting, and identifying a substance according to Claim 1 or 2, wherein the substance is contained in a liquid.

6. The nanogap array method for trapping, detecting, and

identifying a substance according to Claim 1, 2, or 5, wherein the substance is at least one molecule.

7.   The nanogap array method for trapping, detecting, and identifying a substance according to Claim 6, wherein the molecule is a single molecule.

8.   The nanogap array method for trapping, detecting, and identifying a substance according to Claim 1, 2, or 5, wherein the substance is protein.

9.   The nanogap array method for trapping, detecting, and identifying a substance according to Claim 1, 2, or 5, wherein the substance is a biological substance.

10.   The nanogap array method for trapping, detecting, and identifying a substance according to any one of Claims 1 to 9, further comprising a step of modifying the tips of the probes of the cantilevers in advance in order to trap a particular substance.

11.   The nanogap array method for trapping, detecting, and identifying a substance according to any one of Claims 1 to 10, wherein light transmission probes are used to introduce light from the cantilevers to the tips of the probes so as to concentrate the field of the light in the nanogaps so that a nearby target substance is trapped in the gaps via the gradient of the light.

12.   A nanogap array method for trapping, detecting, and identifying a substance, comprising steps of irradiating the

rear surface of a substrate with primary incident laser light such that the laser light is incident on a target substance near gaps at an angle shallower than a critical angle to cause evanescent field excitation; and trapping the nearby target substance in the gaps via the gradient of the field of propagating light generated from tips of probes placed in the evanescent field.

13. A nanogap array device for trapping, detecting, and identifying a substance, comprising:

(a) a cantilever array including cantilevers each having a probe; and

(b) a substrate disposed below the cantilever array, having modified surfaces arranged so as to correspond to the probe of each cantilever;

wherein (c) nanometer-sized gaps are defined between the modified surfaces of the substrate and tips of the probes of the cantilevers to trap, detect, and identify at least one unknown substance between the gaps.

14. The nanogap array device for trapping, detecting, and identifying a substance according to Claim 13, wherein the probes of the cantilevers are modified.

15. The nanogap array device for trapping, detecting, and identifying a substance according to Claim 13, wherein the trapped substance is identified by oscillating the cantilevers to detect mass change or damping change of the

cantilevers due to trapping of the substance as change in vibrational frequency or change in oscillation amplitude.

16. The nanogap array device for trapping, detecting, and identifying a substance according to Claim 13, further comprising a laser Doppler interferometer having an optical excitation function so as to detect and identify properties of the trapped substance.

17. The nanogap array device for trapping, detecting, and identifying a substance according to Claim 13, wherein the cantilever array and a support member supporting the cantilever array comprise a transparent substrate, and the properties of the trapped substance is detected and identified by measuring displacement or amplitude or frequency of the cantilevers by an optical interference method using intervals defined by the cantilevers and the member.

18. A nanogap array device for trapping, detecting, and identifying a substance, comprising:

(a) a cantilever array including cantilevers each having a probe; and

(b) a circular substrate disposed below the cantilever array, having annular grooves to be supplied with at least one unknown substance for being provided on modified surfaces;

wherein (c) nanometer-sized gaps are defined between

the modified surfaces of the substrate and tips of the probes of the cantilevers to trap, detect, and identify the unknown substance.

19. The nanogap array device for trapping, detecting, and identifying a substance according to Claim 18, wherein different substances are provided in the different annular grooves and are simultaneously trapped, detected, and identified.

20. A nanogap array device for trapping, detecting, and identifying a substance, comprising:

(a) a transparent substrate on which samples are provided;

(b) cantilevers having probes, defining an array of nanogaps corresponding to the samples on the transparent substrate; and

(c) at least one substance to be trapped between the probes of the cantilevers and the transparent substrate;

wherein (d) the substance is trapped in the nanogaps by irradiating rear surface of the transparent substrate with primary incident laser light to perform optical measurement.

21. The nanogap array device for trapping, detecting, and identifying a substance according to Claim 20, wherein the primary incident laser light is incident at a position where the substance is disposed at an angle shallower larger than a critical angle to cause evanescent field excitation.

22.   The nanogap array device for trapping, detecting, and identifying a substance according to Claim 20 or 21, wherein the samples are sequentially irradiated and scanned with the primary incident laser light.

23.   The nanogap array device for trapping, detecting, and identifying a substance according to any one of Claims 20 to 22, wherein the transparent substrate is a circular substrate, and the cantilevers having probes are arranged in a radial direction of the transparent substrate.

24.   The nanogap array device for trapping, detecting, and identifying a substance according to any one of Claims 20 to 23, wherein the transparent substrate has annular grooves to be supplied with the substance.

25.   The nanogap array device for trapping, detecting, and identifying a substance according to Claim 24, wherein different substances are provided in the different annular grooves and are simultaneously trapped, detected, and identified.